PART II: RECOVERY

A. Objectives and Criteria:

The ultimate goal of this recovery plan is to restore the Ouachita rock pocketbook, *Arkansia wheeleri*, to a point where protection under the Endangered Species Act is no longer needed. This would be accomplished by conserving the remaining populations and reestablishing viable[1] populations within the species' natural geographic range. Achievement of this goal would allow removal of the species from the Federal List of Endangered and Threatened Wildlife and Plants.

Reclassification to Threatened Criteria

The initial objective is to reclassify the Ouachita rock pocketbook from endangered status to threatened status when:

(1) The existing population in the Kiamichi River is protected[2] from further decline and degradation of its habitat; and

(2) At least two viable populations are successfully reestablished (or found) and protected in two additional stream systems within the natural range of the Ouachita rock pocketbook.

These criteria will be fulfilled by the successful completion of Tasks 1 through 8 and 9.6 outlined in the following pages. It is believed that accomplishment of these tasks will eliminate the likelihood of the species becoming extinct in the foreseeable future. The estimated date for reclassifying the species to threatened is 2023.

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[1] For purposes of this plan, a viable population is defined as a naturally reproducing population large enough to maintain sufficient genetic variation to provide for its continued evolution and response to natural environmental changes. A minimum viable population has not been designated for the Ouachita rock pocketbook, although the Kiamichi River population, estimated as between 1,000 and 2,000 individuals, is regarded as viable, while the Little River population, estimated at less than 100 individuals, is not. The minimum population size needed for long-term viability will be determined through studies prescribed in the recovery plan.

[2] For purposes of this plan, protection is defined as preserving populations of the species, its life history requirements and habitats, sufficient to maintain the species and its habitat in their baseline condition or an improved state, as reflected in population levels, year-class composition, distribution, and other primary indicators of biological health and environmental quality. Complete protection includes prevention, elimination or exclusion of present and foreseeable threats, determination of essential biological requirements, verification of condition through monitoring, and the performance of additional measures as may be needed to ensure continued maintenance of the species and its habitat. The effectiveness and reasonable permanence of protection programs shall be judged by success throughout a minimum of fifteen consecutive years, and an assessment of the adequacy of protective measures established for the species, in light of current information.

Interim Delisting Criterion

The long-term objective of this recovery plan is to delist the Ouachita rock pocketbook. The delisting criterion that follows is considered interim because the opportunity and potential locations for reestablishment are uncertain. Recovery Action 7.2 addresses this uncertainty and calls attention to several important aspects of site selection, including proximity to known populations, and water and habitat quality. In addition, several significant uncertainties pertaining to life history and habitat selection need to be answered; completion of recovery actions 1.22, 4, 4.1., 4.2, 5, 5.1, 5.2, 5.3, 6, 6.1, 6.2, and 7.1 should provide data needed to affirm or revise the recovery criterion. A date to delist the Ouachita rock pocketbook cannot be accurately determined at this time. After the species has been reclassified to threatened, it may be possible to delist it when:

> Viable populations are successfully reestablished (or found) and protected in four major stream systems naturally inhabited by the Ouachita rock pocketbook, including the Ouachita River, Kiamichi River, Little River, and one or more additional tributaries of the Red River basin.

This criterion will be fulfilled by completion of Task 9.7 outlined in the following pages. It is believed that this action will eliminate the likelihood of the species becoming endangered in the foreseeable future.

Tasks 9.1 through 9.5 are not considered essential to the fulfillment of either the criteria for reclassifying to threatened or the criterion for delisting. However, these tasks are considered means for more efficiently and effectively pursuing fulfillment of recovery criteria.

The downlisting and delisting criteria above are preliminary and may be revised on the basis of new information.

This recovery plan is a guide to be used by the FWS and individuals, organizations, and other agencies working to recover the Ouachita rock pocketbook. As the plan is implemented, revision will likely be necessary. Sound management of the species and close coordination among management entities should provide more stable habitat and population structure for the Ouachita rock pocketbook and restore it to a less endangered status.

B. Narrative Outline for Recovery Actions:

1. Preserve existing Ouachita rock pocketbook population and habitat in the Kiamichi River in Oklahoma. The only known population of this species considered to have long-term viability occurs in the mainstem of the Kiamichi River from near the upper reaches of Hugo Reservoir, Oklahoma, upstream to Whitesboro, Oklahoma. That population contains a large majority of the known living Ouachita rock pocketbooks, and is essential to the survival and recovery of the species. Habitat of the Kiamichi River population has been impacted by reservoir construction and water quality degradation. Potential future threats include construction of the authorized Tuskahoma Reservoir, conceivable operations of Sardis Reservoir and smaller impoundments, large water withdrawals from the river upstream of Hugo Reservoir, and further degradation of water quality. Without the

protection of the Kiamichi River population and its habitat encompassed by these tasks, the Ouachita rock pocketbook is almost certain to become extinct.

1.1 Use existing statutes to protect the Kiamichi River system where the Ouachita rock pocketbook occurs. The Endangered Species Act, the Fish and Wildlife Coordination Act, and other environmental statutes provide a measure of protection for this species. Activities governed by existing statutes and with potential to adversely affect the inhabited extent of the Kiamichi River must be carefully designed and implemented to prevent adverse impacts to the Ouachita rock pocketbook and its habitat. All entities that may adversely affect the species should consider it in project planning, construction, and operation, and provide adequate protection from the effects of actions taken. Species protection and achievement of other objectives are most likely to be successful where interested parties cooperate in these efforts and consider environmental issues from the outset of project planning.

This task will consist largely of continued consultation by federal agencies with the FWS in accordance with Section 7(a)(2) of the Endangered Species Act. That section requires federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of endangered species such as the Ouachita rock pocketbook. The full range of federal agencies and activities involved in consultation cannot be anticipated, but will likely include U.S. Army Corps of Engineers (CE) multipurpose reservoir activities; CE permit programs regulating placement of fill and structures in waters of the United States; U.S. Environmental Protection Agency (EPA) programs overseeing state water quality standards, point source and nonpoint source controls, solid waste disposal, and pesticide registration; U.S. Forest Service (FS) management activities on the Ouachita National Forest; Federal Highway Administration (FHWA) bridge and highway construction projects; Farm Service Agency (FSA) inventory transfers, other U.S. Department of Agriculture (USDA) agriculture assistance programs, and Federal Energy Regulatory Commission (FERC) programs regulating pipelines and non-federal hydroelectric projects. Consultations regarding the Kiamichi River population of the Ouachita rock pocketbook may involve, as applicants or non-federal representatives, various representatives of the State of Oklahoma, local authorities, and private parties. The FWS must keep pertinent parties aware of the need for consultation and fulfill its responsibilities in a constructive, timely, and biologically sound manner.

This task also will involve actions under Sections 9 and 10 of the Endangered Species Act. Those sections set forth prohibitions and exceptions that, in part, make it illegal to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt any of these), import or export, ship in interstate commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. It is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Certain exceptions apply to agents of the FWS and state conservation agencies. Permits may be issued to carry out otherwise prohibited activities involving endangered species under certain circumstances. Such permits are available for scientific purposes, to enhance the propagation or survival of the species, and/or for incidental take in connection with otherwise lawful activities.

The Kiamichi River is covered by existing requirements that provide for protection of a basic level of water quality. Water quality protection is administered primarily by the states (although the EPA maintains an oversight authority, which can be reviewed under the Section 7 consultation procedures mentioned above). In Oklahoma, most program responsibilities are placed with the Oklahoma Department of Environmental Quality and the Oklahoma Water Resources Board, although others are distributed among additional agencies. Although existing water quality standards for the Kiamichi River are not based on specific needs of the Ouachita rock pocketbook, their enforcement can maintain water quality that is generally supportive of aquatic life. Existing water quality standards and other water quality requirements (e.g., point source discharge permit limitations) presently receive incomplete enforcement due to factors such as limited program resources that produce, for example, a near total reliance on self-monitoring data reported by dischargers. Existing programs also include tolerance for a certain number and degree of violations and generally allow dischargers to approach full compliance over extended periods. Existing standards and associated water quality requirements should be stringently enforced for the Kiamichi River and its tributaries. Information on all potential violations of these standards or requirements should be immediately reported to appropriate officials, investigated, and corrected. Dischargers should invest adequate funds into construction and operation of treatment facilities (using assistance programs, where appropriate) and enforcement programs should receive adequate funding, to eliminate funding deficiencies as factors limiting compliance.

Oklahoma Department of Wildlife Conservation (ODWC) statutes prohibit collection of the Ouachita rock pocketbook in the course of commercial mussel harvest, and also prohibit attempts to possess, hunt, chase, harass, capture, shoot, wound, kill, take, or trap endangered species such as *A. wheeleri*. ODWC regulations designate the Kiamichi River as a mussel sanctuary, in which no commercial mussel harvest is allowed, and prohibit the collection or sale of threatened or endangered species of mussels. In addition, ODWC regulations designate the Kiamichi River upstream from Highway 271, and its tributaries, as areas closed to seining by commercial minnow dealers. Those restrictions add protection for the Ouachita rock pocketbook, and should be strictly enforced.

1.2 Provide additional measures needed to achieve basic protection of the Kiamichi River population. Adequate protection of the Ouachita rock pocketbook in the Kiamichi River will require additional measures that are not fully provided for by existing authorizations and requirements. For some protective measures, proper authorization does not yet exist. In other cases, limited authorizations may exist, but their use to protect the Ouachita rock pocketbook may be inadequate. Such use may be more discretionary or less specifically prescribed, requiring creative application and implementation. While requirements of the Endangered Species Act provide protection for *A. wheeleri* and its habitat, other programs and measures may provide alternate protection that landowners find preferable to regulatory approaches (e.g., eventual development of a habitat conservation plan).

1.21 Deauthorize Tuskahoma Reservoir. This reservoir is presently authorized for construction by the CE and poses a serious threat to the Ouachita rock pocketbook's

continued existence and recovery. Impoundments have already caused much of the decline experienced by this species. While any project significantly affecting *A. wheeleri* is a source of concern, the Tuskahoma project is of special concern because it would (1) displace by the dam and conservation pool approximately 19% of the 88-mi river section inhabited by the sole viable population, (2) likely reduce the inhabited section further, by headwater and tailwater effects, and (3) effectively block genetic exchange among any portions of the population left upstream and downstream of the reservoir. Numbers and distribution of the Ouachita rock pocketbook would both be significantly reduced. Although Tuskahoma Reservoir can be evaluated further through Section 7 consultation (Task 1.1), the project appears to pose inherent impacts that would severely interfere with the species' survival and efforts for its recovery. Alternatives likely exist that would meet needs to be served by the reservoir with less adverse or even beneficial effects on the mussel and its habitat. Therefore, the Tuskahoma Reservoir project should be deauthorized. Until deauthorization is accomplished, *A wheeleri* should not be delisted. Authority to deauthorize a project such as Tuskahoma Reservoir lies with the U.S. Congress. Removal of this threat is essential to prevent extinction.

1.22 Determine value of major tributaries as habitat for the Kiamichi River population. The Ouachita rock pocketbook has been characterized as inhabiting certain habitats within the mainstems of rivers. However, both archaeological and recent evidence indicate possible occurrence of the species in Jackfork Creek, a major tributary of the Kiamichi River (Bogan and Bogan 1983, A.D. Martinez, unpublished data). Report of *A. wheeleri* shells from Pine and Sanders creeks in Texas (Howells *et al.* 1996, 1997) also indicate the possibility of the species inhabiting large tributaries of rivers. Discovery of significant Ouachita rock pocketbook numbers in tributaries of the Kiamichi River would increase the recognized size of the river population and the area of habitat requiring protection. Main tributaries, including Jackfork Creek, Pine Creek, Buck Creek, Tenmile Creek, and Cedar Creek, should be surveyed further for *A. wheeleri* at selected, inadequately surveyed sites, using scuba when mussels are found and the water depth is more than 100 centimeters (cm). Habitat conditions and apparent threats should be assessed concurrently.

1.23 Perform cooperative projects to increase protection of Ouachita rock pocketbook habitat in the Kiamichi River. Section 7(a)(1) authorizes federal agencies to carry out programs to conserve listed species such as *A. wheeleri*. The FWS will assist other federal agencies in developing and carrying out such programs, as well as undertake its own programs, to conserve this species. Section 6 of the Endangered Species Act provides for the FWS to grant funds to states for management actions aiding the protection and recovery of listed species. Section 6 funds should continue to be made available to the State of Oklahoma for Ouachita rock pocketbook recovery. Other programs (e.g., FWS Partners for Fish and Wildlife Program; EPA Nonpoint Source Program; and USDA Conservation Reserve Program, Environmental Quality Incentives Program, Forestry Incentives Program, Stewardship Incentive Program, and Wetlands Reserve Program) provide additional

means of developing cooperative projects that could be used to protect the river environment, while retaining lands in private ownership. These programs differ somewhat in the objectives and practices they support; consequently, development of individual projects to benefit *A. wheeleri* will require consideration of program differences as well as environmental objectives. Participants in cooperative programs may include a broad variety of public and private parties. The total cost of task completion will be determined by the amount of private and governmental participation.

1.24 Upgrade protection provided to the Kiamichi River through water quality standards and water quality management programs. In addition to enforcing existing water quality requirements, it is important to seek improvements where those requirements offer incomplete protection to the Ouachita rock pocketbook and its habitat. A special beneficial use category should be defined for waters containing *A. wheeleri* habitat, and criteria developed that more accurately reflect the species' environmental needs (e.g, as determined through Task 5). Once determined, such a category and criteria should be included in the Oklahoma Water Quality Standards and applied to the Kiamichi River. To protect existing water quality while specific standards are developed, the river and its tributaries should receive the highest level of protection under the state's anti-degradation policy.

Best management practices (BMPs) have been developed to control nonpoint sources of pollution, but application of those practices in Oklahoma, presently on a volunteer basis, has been limited. The limited extent of treating nonpoint sources should be remedied, and the adequacy of implemented BMPs verified. Other elements of Oklahoma's water quality management program should be upgraded to increase protection of the Kiamichi River (e.g., evaluations of the effectiveness of point source discharge requirements to remove biological toxicity).

1.25 Develop and implement a strategic habitat protection plan for the Kiamichi River. Protection of the Kiamichi River Ouachita rock pocketbook population can be most effectively accomplished by developing a strategic or systematic protection plan. The plan would identify and place a priority on protective measures benefitting the most important habitat sites, treating the most important or most readily alleviated threats, or presenting other key opportunities to benefit the species. At the same time, such a plan could promote consistency among properties regarding conditions needed to protect habitat quality. One valuable component of such a plan would be development of a computerized database containing relevant information in a form suitable for query and analysis, e.g., within a geographic information system (GIS). This effort should consider enlisting the assistance of Oklahoma's Natural Areas Registry Program (administered by the Oklahoma Natural Heritage Inventory).

1.251 Inventory property ownerships on and along the Kiamichi River and water rights appropriations. To support other recovery tasks, an ownership map should be prepared for all properties having a potential to affect portions

of the Kiamichi River inhabited by the Ouachita rock pocketbook. Appropriated rights to river flows also should be inventoried.

1.252 Ensure public landowner notification. Pursuit of Tasks 1.1 and 1.23 will identify many federal, state, county, and municipal landowners along the Kiamichi River, but perhaps not all. Efforts should be made to ensure that all governmental entities holding properties along the river are aware of the Ouachita rock pocketbook's status, recovery efforts being made, entity responsibilities to protect the species, and opportunities to assist in its recovery. Efforts should be made to ensure that governmental entities incorporate consideration for *A. wheeleri* into their respective management plans to the greatest extent possible.

1.253 Ensure private landowner notification. Most lands within the Kiamichi River basin are privately owned. Efforts should be made to ensure that private owners (at least those owning lands that are most significant to the Ouachita rock pocketbook) are aware of the species' status, need for protection of the species and its habitat, recovery efforts being made, and the role of private landowners in species protection and recovery.

1.254 Manage response to identified threats. Site-specific threats to the Kiamichi River population will continue to be identified through a variety of avenues, including by responsible parties, by other interested parties, by monitoring programs (Task 1.3), by new research studies, and by other means. Appropriate responses to such threats, including the involvement of pertinent authorities, will be largely determined by the nature of specific threats, as well as their potential significance. Information, program commitments, and administrative relationships should be developed that facilitate response to individual threats, including objective assessments of basis and magnitude, determination of proper jurisdiction, notification of appropriate parties, adequate investigation and treatment, and follow-up.

1.255 Develop protection approaches for specific areas. This task will add to the specific public and private areas protected along the Kiamichi River under Tasks 1.1, 1.23, and 1.254. Options for protection by various parties will be explored, including cooperative agreements; technical and financial assistance; easement or fee title purchase, transfer, or donation; leases; regulation; enrollment in ONHI's Natural Areas Registry Program; identification of specific river reaches as essential habitat; and any need to reconsider critical habitat designation for the species. A model easement conveyance should be drafted incorporating specific rights needed to protect the Ouachita rock pocketbook. The FWS would work with willing property owners to convey landholdings and water rights into public ownership if this would benefit species protection. Prior to development of all elements needed for a strategic protection plan (Task 1.256), recovery

participants will pursue protection of specific areas using a professional judgement of resource needs and opportunities.

1.256 Integrate initial protections into a systematic habitat protection plan. Specific habitat protection efforts would be most effectively pursued and tracked within a systematic protection plan. Under this task such a plan would be prepared, including development of a database containing information referenced in Tasks 1.251-1.255, as well as information on known locations, quality, and quantity of mussel habitat. The plan would provide a means of integrating pertinent information and systematically identifying protection priorities based on criteria such as aquatic targets (Higgins *et al.* 1999), other location-specific resource values, threat characteristics, landowner interest, and alternative management strategies (Saunders *et al.* 2002). As part of this task, recovery participants also will determine how each will use the plan. Actual selection of protection projects may deviate at times from the plan according to specific participant interests, funding levels and sources, and other considerations.

1.3 Institute a monitoring program to ensure continued viability of the Kiamichi River population. A comprehensive trend monitoring program should be developed and implemented at selected sites in the Kiamichi River basin to track population trends, habitat quality and quantity, and threats; to evaluate recovery efforts; and to ensure the population does not decline nor habitat degrade from preventable impacts. The monitoring program must include assessments performed specifically for these purposes, but also may make use of data collected for other purposes (e.g., state water quality assessment monitoring, point source compliance monitoring). Design of the monitoring program (including specific stations, timing, parameters, and methodologies) should consider preceding studies (as evaluating particular study designs and establishing records of potential comparative value), but also should have benefit of a 3-year developmental period during which an expanded suite of parameters is evaluated. Long-term monitoring would incorporate the best, low-impact indicators of the most important conditions. Without periodic monitoring, this species could become extinct.

1.31 Develop and implement monitoring of the Kiamichi River population and its habitat. Parameters that reflect key aspects of biological condition should be monitored at selected sites. Monitored parameters should include number of Ouachita rock pocketbooks present, individual shell dimensions and ages, plus numbers and shell lengths of associated mussel species. Ouachita rock pocketbooks found should be marked (using a noninjurious method) and recaptures recorded. Biological and habitat monitoring must be performed by knowledgeable biologists who can readily identify the species, obtain the necessary data, and carefully return the mussels alive to their habitats with a minimum of disturbance. Biological monitoring should occur at not more than 3-year intervals at any one locality. Initially, habitat monitoring should at least include water depth, velocity, temperature, dissolved oxygen, ammonia, nitrates, phosphates, pH, specific

conductance, turbidity, suspended sediments, substrate composition, aquatic vegetation, canopy vegetation, suitable habitat available, adjacent land use, upstream land use, plus riparian thickness and health.

1.32 Develop and implement monitoring of current and potential threats to the Kiamichi River population. Parameters indicative of active or potential threats to the Ouachita rock pocketbook should be monitored, including water discharge (flow) modifications, channel modifications, point source and nonpoint source contributions, land use, and contamination of the river environment. Threat monitoring should collect information from a variety of sources, including broad assessments (e.g., basinwide aerial photography, satellite imagery), more specific appraisals (e.g., habitat monitoring, point source compliance data, records of agricultural chemical applications, inventories of permitted gravel mining operations), and investigations of specific activities (e.g., citizen reports, applications for Section 404 permits).

2. Determine viability of populations outside the Kiamichi River system. A relatively complete knowledge of the Ouachita rock pocketbook's current distribution (as can be determined in the short-term) is essential to ensure against further decline in the species' status and provide for the soundest possible conservation and recovery efforts. Live *A. wheeleri* individuals were found in the lower Little River, Arkansas, in 1987 (Clarke 1987) and in Oklahoma in 1994 (Vaughn *et al.* 1995). Empty Ouachita rock pocketbook shells were collected over a longer section of the Little River, Oklahoma, as recent as 1991-1994 (C.M. Mather, pers. comm. 1993, Vaughn 1994, Vaughn *et al.* 1995). *A. wheeleri* has been collected over a considerable portion of the Ouachita River, Arkansas, and the species' continued existence in the river was verified from a single live individual encountered in 1995 (Posey *et al.* 1996). Empty Ouachita rock pocketbook shells were collected from Pine and Sanders creeks, two Red River tributaries in Texas, in 1992 and 1993 (C.M. Mather, pers. comm. 1993, Howells *et al.* 1996, 1997). Selected sites in those streams, and possibly others, should be surveyed further to determine the presence or absence of living *A. wheeleri.* If present, determinations should be made of whether or not each population found is viable and the extent of existing or needed relationships with other populations (Vaughn 1993). General habitat quality and quantity and vulnerability to threats should be assessed as a part of each survey. The surveys must be performed by knowledgeable biologists who can readily identify the species, obtain the necessary data, and carefully return the mussels alive to their habitats with minimum disturbance.

2.1 Conduct a survey of the Little River in Arkansas and Oklahoma for existing populations. A small population is believed to persist within portions of an approximately 69-mi section of the Little River between Wright City, Oklahoma, and the river's confluence with the Rolling Fork River in Arkansas. A survey of the Little River in 1987 found a small number of live Ouachita rock pocketbook specimens, all in Arkansas between the state line and the river's confluence with the Rolling Fork River (Clarke 1987). Later (1994) surveys of the Little River found live *A. wheeleri* in the short section in Oklahoma between U.S. Highway 70 and the river's confluence with the Mountain Fork River, but empty shells also were found at additional points, upstream and downstream, during 1991-1994 (C.M. Mather, pers. comm. 1993; Vaughn 1994, Vaughn *et al.* 1995). Most of the shells found in Oklahoma

were relatively weathered; however, two sets of valves (shell halves) were in good condition and appeared to represent relatively recent Ouachita rock pocketbook deaths. It is usually difficult to judge how long specimens found in such cases have been dead, and no estimates are given for the shells found in the Little River. The species persists in the Little River in Oklahoma and possibly Arkansas; however, the total distance currently inhabited remains uncertain. Habitat in the Little River has been impacted by reservoir construction and degraded water quality, and further water quality degradation is an identified threat. Surveys for *A. wheeleri* should be continued on that stream at selected, inadequately surveyed sites, using scuba when mussels are found and the water depth is more than 100 cm. Habitat conditions and apparent threats should be assessed concurrently.

2.2 Conduct surveys of the Ouachita River in Arkansas for existing populations. This species seems to persist within the Ouachita River in Arkansas. Although most recent surveys have found no live Ouachita rock pocketbooks and some researchers have reported degraded habitat conditions, one live individual was documented recently and portions of the river continue to support diverse mussel assemblages (Posey *et al.* 1996). Habitat in the Ouachita River has been impacted by construction of impoundments, channelization, and water quality degradation, and further channelization and impoundment in the basin constitute future threats. However, continued search of the Ouachita River is warranted, including efforts to locate and examine large mussel beds in mainstem shoals, side channels, and backwaters, between Lake Catherine and Lake Jack Lee, Arkansas. The use of scuba is recommended to search mussel beds where water depth is more than 100 cm. Information on habitat conditions and threats should be updated during these surveys.

2.3 Conduct surveys of other Red River tributaries in Oklahoma, Texas, and Arkansas for existing populations. Single empty *A. wheeleri* shells were collected in 1992 from Pine Creek and in 1993 from Sanders Creek, both in Lamar County, Texas (C.M. Mather, pers. comm. 1993, Howells *et al.* 1996, 1997). Although it is difficult to judge precisely how long such specimens have been dead, the Texas shells appeared to represent recently expired Ouachita rock pocketbooks. The species may inhabit these creeks or other tributaries of the Red River beyond those from which it is known historically. Factors that might have impacted habitat for the mussel in those tributaries or might constitute future threats have not yet been assessed. Certain Red River tributaries near the Kiamichi River and Little River may have offered suitable habitat for the Ouachita rock pocketbook. Inadequately surveyed streams should be examined for *A. wheeleri* at selected sites, using scuba where water depth exceeds 100 cm. Habitat conditions and threats should be assessed concurrently.

2.4 Determine if any populations found in Tasks 2.1, 2.2, or 2.3 are viable. When Ouachita rock pocketbooks are encountered in the previously-described surveys, all individuals should be measured and their ages estimated in order to assess recruitment, growth, and longevity trends. Estimates of *A. wheeleri* density and available habitat are desirable to provide for future population trend determinations. Follow-up monitoring at not more than 3-year intervals to establish trends over a minimum of a 15-year period will be used to determine

population viability. Relationships with other populations or sub-populations of *A. wheeleri* in connected drainages should be evaluated.

3. Preserve any additional population of the Ouachita rock pocketbook found in Tasks 2.1, 2.2, and 2.3, its associated habitat, and restore degraded habitat in the Ouachita River, Little River, and other areas producing evidence of extirpated or depressed populations of the Ouachita rock pocketbook.

3.1 Use existing statutes to restore and protect habitat for the Ouachita rock pocketbook. The Endangered Species Act, the Fish and Wildlife Coordination Act, and other environmental statutes provide some means to restore and protect habitats and impacted populations of this species. The Endangered Species Act is most easily applied to areas where the species still exists (such as in a portion of the Little River in Oklahoma), but other regulatory measures exist that can be used to restore and protect areas that are not currently suitable for the species. This task will consist of efforts to protect *A. wheeleri* populations and restore degraded habitat outside of the Kiamichi River, using actions similar to those performed under Task 1.1. Federal agencies must ensure activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of endangered species such as the Ouachita rock pocketbook. Consultations may involve, as applicants or non-federal representatives, various representatives of the states of Arkansas, Oklahoma, and Texas, local authorities, and private parties. This task also will involve actions under Sections 9 and 10 of the Endangered Species Act.

All waters in which *A. wheeleri* may occur are covered by existing requirements that provide for basic water quality protection. Water quality protection is administered primarily by the states, although agency responsibility for program elements and the activities that affect water quality varies from state to state. Although existing water quality standards for degraded habitats of the Ouachita rock pocketbook are not based on specific needs of the species, their enforcement can maintain water quality that is generally supportive of aquatic life. Existing water quality standards and associated water quality requirements should be strictly enforced for those areas containing *A. wheeleri*. Information on all potential violations of these standards or requirements should be immediately reported to appropriate officials, investigated, and corrected.

Arkansas Game and Fish Commission (AGFC) regulations make it illegal to import, transport, sell, purchase, take or possess any endangered species of wildlife or parts of such wildlife. ODWC statutes prohibit attempts to hunt, chase, harass, capture, shoot, wound, kill, take, or trap endangered species such as the Ouachita rock pocketbook. ODWC statutes and regulations governing commercial mussel harvest also prohibit the collection or sale of threatened or endangered species of mussels. Texas Parks and Wildlife Department (TPWD) statutes and regulations make it illegal to possess, take, or transport endangered fish or wildlife for zoological gardens, scientific purposes, or commercial propagation without special permit. AGFC and TPWD designate certain waters inhabited by the Ouachita rock pocketbook as mussel sanctuaries. All of these existing restrictions that relate to *A. wheeleri* should be strictly enforced.

3.2 Provide additional measures needed to achieve restoration and protection of degraded habitats and populations. Restoration and protection of degraded habitats and populations of the Ouachita rock pocketbook will require additional measures that are not fully provided for by existing authorizations and requirements. For some conservation measures, proper authorization does not yet exist. In other cases, limited authorizations may exist, but their use to recover *A. wheeleri* may not be adequate. Such use may be more discretionary or less specifically prescribed, requiring creative application and implementation. While requirements of the Endangered Species Act provide for the recovery of the Ouachita rock pocketbook, other programs and measures may provide means of recovering the species that are preferable to alternative regulatory protection (e.g., eventual development of a habitat conservation plan).

3.21 Deauthorize unimplemented channel modifications of the Ouachita River. Early water resource planning for the Ouachita River basin led to the 1950 authorization of many development projects, most of which were eventually constructed. A number of low priority projects were not completed, including 11 cutoffs and 14 bend widenings on the Ouachita River, and Murfreesboro Lake on the Muddy Fork of the Little Missouri River. Those projects would cause additional modification of the natural characteristics of the Ouachita River, and could be contrary to the interest of restoring suitable habitat for the Ouachita rock pocketbook in that river system. The projects mentioned are presently inactive. Their deauthorization could support efforts to recover the Ouachita rock pocketbook. Authority to deauthorize such projects lies with the U.S. Congress.

3.22 Develop and implement cooperative projects to increase restoration and protection of degraded habitat and populations of the Ouachita rock pocketbook. Section 7(a)(1) of the Endangered Species Act authorizes federal agencies to carry out programs to conserve listed species. The FWS will assist other federal agencies in developing and carrying out such programs, as well as undertake its own programs, to conserve *A. wheeleri*. Section 6 of the Endangered Species Act provides for the FWS to grant funds to states for management actions aiding the protection and recovery of listed species. Section 6 funds should continue to be made available to the states of Arkansas, Oklahoma, and Texas for Ouachita rock pocketbook recovery. Other programs (e.g., FWS Partners for Fish and Wildlife Program, Private Stewardship Grants Program, and Landowner Incentive Program; EPA Nonpoint Source Program; and USDA Stewardship Incentive Program, Water Quality Incentive Program, Conservation Reserve Program, and Wetlands Reserve Program) provide additional means of developing cooperative projects that could be used to restore this species' habitat, while retaining lands in private ownership. These programs differ somewhat in objectives and practices they support; consequently, development of individual projects to benefit *A. wheeleri* will require consideration of program differences as well as environmental objectives. Participants in cooperative programs may include a broad variety of public and private parties.

3.23 Upgrade protection provided to degraded areas of habitat for the Ouachita rock pocketbook through water quality standards and water quality management programs. In addition to enforcing existing water quality requirements, it is important to seek improvements where those requirements offer incomplete protection to the Ouachita rock pocketbook and its habitat. A special beneficial use category should be defined for waters containing *A. wheeleri* habitat, and criteria developed that more accurately reflect the species' environmental needs. Once determined, such category and criteria should be included in Arkansas, Oklahoma, and Texas water quality standards and applied to waters that historically or recently contained the species. Special high quality water designations also should be applied to such waters to help protect natural water quality levels. Other elements of the states' water quality management programs also should be upgraded to increase restoration and protection (e.g., accelerated treatment of nonpoint pollution sources).

3.3 Institute a monitoring program to verify preservation of any additional populations found, augmentation of initially depressed populations, and restoration of initially degraded habitat. A comprehensive trend monitoring program should be developed and implemented at selected sites of the Ouachita River, Little River, and other appropriate waters to track population trends, habitat quality and quantity, and threats; to evaluate recovery efforts; and to ensure against further population declines and habitat degradation from preventable impacts. The monitoring program must include assessments performed specifically for these purposes, but also may use data collected for other purposes. Design of the monitoring program should consider preceding surveys and studies, and include the features specified under Tasks 1.31 and 1.32 for the Kiamichi River. The monitoring program also should have benefit of a 3-year developmental period during which an expanded suite of parameters is evaluated. Long-term monitoring would incorporate the best, low-impact indicators of the most important conditions. Without periodic monitoring, important populations of this species could become extirpated due to a lack of current information on adverse conditions and the populations' status.

4. Conduct reproductive studies of the Ouachita rock pocketbook. For this species, survival cannot be ensured nor recovery accomplished until details of reproduction are known, including the natural fish host(s) and timing of reproduction. Techniques that minimize sacrifice of individuals from natural populations must be used, to the extent possible. (Examples include nonlethal examination of individuals (with/without anesthetization), salvage and examination of individuals killed incidentally; use of DNA fingerprinting to identify glochidia and successful infestations on hosts; nonlethal methods of sexing individuals from small, excised tissue samples; production of an experimental, cultured population; and development of such techniques using more common surrogate species). Once determined, essential aspects of reproduction must be protected as a part of management for the species.

4.1 Determine and protect the fish host(s) and its(their) required habitat. Protection of the fish host(s) and its/their required habitat is essential to the survival and recovery of the Ouachita rock pocketbook. Identification of the one or more fish species that serve as host for *A.*

wheeleri glochidia must be performed before specific host protection can be pursued. Fish species that serve as hosts for closely related mussels and fish species that share the same natural distribution and habitat preference as the Ouachita rock pocketbook should be selected as likely candidates. Following selection of likely host species, it will be necessary to artificially infest them with glochidia and determine if the glochidia encyst and develop into juvenile mussels. Successful replicate experiments should be achieved to ensure that host identification is accurate. Once the fish host(s) is identified, its habitat requirements must be determined. Then, host species' habitat requirements and access to populations of the mussel must be integrated into habitat management programs to ensure continued *A. wheeleri* survival.

4.2 Determine sex ratio among Ouachita rock pocketbooks, age at which they achieve sexual maturity, number of years they continue gamete production, and seasonal timing of reproductive events. The sex ratio of Ouachita rock pocketbooks, normal ages during which the species is capable of reproduction and seasonal timing of reproductive events (e.g., fertilization, gravidity, glochidial release) are critical factors in assessing potential impacts to the species and its rate of recovery. Studies to determine these aspects will be performed under this task. To minimize impacts to extant populations, normal values for these parameters will initially be estimated from a small number of individuals, but will be refined over time as techniques improve to study reproduction without sacrificing individuals from wild populations.

5. Conduct further studies of habitat requirements and preferences of the Ouachita rock pocketbook. Detailed studies of habitat used by this species have been performed for the Kiamichi River population, but should be supplemented by study of other populations and conditions. Additional study also is needed of habitat requirements for juvenile forms and sensitivities of all life stages. These studies are necessary to provide effective management of the species' habitat. The studies must use techniques that minimize sacrifice of individuals from wild (natural) populations. (Examples include modeling of natural conditions; extended study of individuals *in situ;* production of an experimental, cultured population; study of tissue glycogen levels, shell closing/gaping, filtration rates, growth, density, population structure, and other evident, repeatable indicators of disturbance; and study of sensitivities in more common associated species). Once determined, additional habitat requirements must be integrated into efforts to recover the species.

5.1 Determine habitat use patterns of Ouachita rock pocketbook populations outside of the Kiamichi River. Detailed studies of habitat occupied by this species have been performed for the Kiamichi River population. Although those studies establish a basic understanding of habitat utilization, the various waterbodies from which the species is known differ enough in environmental characteristics to warrant study of habitat use by populations outside of the Kiamichi River. Results of such studies will be used to refine management actions to restore and protect suitable habitat for *A. wheeleri* throughout its natural range.

5.2 Determine habitat requirements and early life history characteristics of juvenile Ouachita rock pocketbook mussels. Within individual mussel species, juveniles can be adapted to different habitats than adults. Moreover, adult mussels are frequently capable of

withstanding environmental disturbances that result in the death of juveniles. Additional study is needed to define the habitat requirements and sensitivities of juvenile Ouachita rock pocketbooks. Once determined, the habitat requirements of juveniles must be protected to ensure continued survival of *A. wheeleri.*

5.3 Determine environmental sensitivities of the Ouachita rock pocketbook. The Ouachita rock pocketbook appears to be sensitive to habitat degradation. Habitat studies to date have partially characterized the predominant nature of sites inhabited by members of the largest remaining *A. wheeleri.* Knowledge is still incomplete regarding the full range and dynamics of conditions in suitable habitats, and critical differences between suitable and unsuitable habitats. This is particularly true of high-flow conditions and human-induced modifications. For example, the Ouachita rock pocketbook may continue to inhabit many localities downstream from Sardis Reservoir, but recent conditions there may not represent optimum ones for growth and reproduction (Vaughn *et al.* 1993, Vaughn and Pyron 1995). Additional study is needed of physical, chemical, and biological conditions (including macrohabitat variables, additional flow variables, and food items) in habitats throughout the species' range, of further conditions that would accompany conceivable developments, and responses of *A. wheeleri* to each of these factors. Results of such study will enhance the ability to restore and protect suitable habitat for the Ouachita rock pocketbook. Unknown habitat requirements and sensitivities (i.e., tolerances) are likely critical to survival and recovery of *A. wheeleri.*

6. Evaluate genetic and population characteristics of existing populations of the Ouachita rock pocketbook. Timely reestablishment of Ouachita rock pocketbooks in restored habitats is likely to require artificial translocation of individuals from existing populations. If multiple populations still exist, it is important to know the genetic composition of each population before using them as stock to reestablish or augment populations. In addition, long-term management of the species will require an understanding of each population's characteristics and factors that affect its viability. Such studies should develop and use techniques that minimize sacrifice of individuals from natural populations. (Examples include salvage and analysis of individuals killed incidentally; nonlethal analysis of individuals using small, excised tissue samples; production of an experimental, cultured population; and development of such techniques using more common surrogate species).

6.1 Determine comparative genetic composition of extant populations. This task will analyze the genetic composition and variability of the Kiamichi River population, as well as any other population(s) found. In addition, studies will evaluate the genetic similarity of different populations, the value of different populations as sources from which to reestablish or augment populations, and the potential for unaided genetic exchange among populations.

6.2 Determine factors that limit population growth, and refine characterization of population viability for the species. This task will evaluate results from distributional surveys; habitat, reproductive, and genetic studies (e.g., population size, density, longevity, recruitment, sex ratio, reproductive timing, fecundity, glochidial host(s), habitat specificity, and habitat availability); and assess other factors indicated to be important (e.g., geographic constraints, physiological condition of mussels, causes of mortality). Factors that limit population

growth, as well as those most easily treated to enhance population growth, will be determined. Investigations will be designed to develop improved characterizations of population viability for the species, and determine the optimum number, arrangement, and interaction of populations. These studies are needed to refine recovery objectives and criteria as well as specific management actions, and may indicate a need to perform additional actions.

7. Establish two viable populations outside the Kiamichi River system, if these populations do not already exist, and protect. Reestablishment of the Ouachita rock pocketbook outside of the Kiamichi River system would reduce susceptibility of the species to catastrophic threats (such as a large spill of toxic material). Reestablishment in areas from which the species has been extirpated also would return the species to a broader ecological setting for its continued evolution and adaptation. Artificial barriers or other factors may prevent natural repopulation of areas in which suitable habitat conditions are restored. In other cases, small populations may exist but contain insufficient numbers or densities of individuals to achieve long-term viability. *A. wheeleri* individuals should be relocated from the healthy Kiamichi River population (or other justifiable sources) to other sites within the species' natural range, as necessary to meet recovery objectives. Transplants will be accomplished as capabilities and suitable site conditions are obtained, unless the existence of other viable populations, or populations approaching viability, has been documented within the natural range. These tasks should use techniques that minimize sacrifice of individuals from natural populations. (Examples include production of an experimental, cultured population; and development of techniques using more common surrogate species).

7.1 Develop technique(s) for successfully reestablishing or augmenting populations by transplantation. Techniques for transplanting mussels are incompletely developed, and attempts to relocate individuals of sensitive species have often produced significant mortalities. Therefore, this task will develop at least one effective technique for transplanting Ouachita rock pocketbooks. Use of individuals from the Kiamichi River population should be carefully controlled to maintain the health of that population. If accomplished, captive mussel propagation could provide a preferred source for stocking efforts to enhance recovery. Following technique development, the feasibility of using it on a scale sufficient to reestablish populations or population viability should be evaluated.

7.2 Select stream sites for introduction. Transplantation efforts should be directed toward sites that offer suitable conditions and where future protection can be provided. Streams and specific stream sites for introduction will be selected based on need of existing populations to be supplemented, location within the species' natural range, geographic relationship to other populations, plus present and expected future habitat and water quality. The occurrence of small populations or of fresh empty shells of the Ouachita rock pocketbook will be used as one indication that minimum requirements for the survival of the species may be present. The process of identifying candidate sites will involve a number of federal and state agencies, local governments, and other interested parties.

7.3 Translocate Ouachita rock pocketbooks into two populations outside of the Kiamichi River system. The species should be translocated into selected sites, contingent upon conditions

still indicating that such introduction is needed and appropriate. Donor populations will be selected using information on population levels and genetic characteristics.

7.4 Protect transplanted populations and evaluate success. Restoration and protective measures should be continued for the areas into which Ouachita rock pocketbooks are transplanted (in all or most cases, these measures will have begun under Task 3). The success of all translocations should be monitored and evaluated, and used to influence decisions on subsequent attempts.

8. Develop an outreach program. Recovery of the species will require support and assistance from governmental entities, commercial interests, agricultural interests, conservation interests, and private citizens. For the Kiamichi River basin and other places where the Ouachita rock pocketbook may exist, a program should be developed and implemented to communicate with interested parties. Information should be produced describing the plight of this endangered species, its ecological needs and their relationship to human activities, its protection and recovery under the Endangered Species Act, the variety of avenues available for benefitting the species and its habitat, the importance of maintaining genetic diversity, the value of mussels in ecosystem functioning and as indicators of environmental health, and the mussel's representation of the region's unique natural heritage. Public and private parties will be encouraged to assist in implementing the outreach program.

9. Enhance management by increased technical knowledge, improved coordination of monitoring/research and management, and attention to special management needs. Continued improvements will be sought in programs that enhance survival and recovery of the Ouachita rock pocketbook. For example, prompt and thorough distribution of monitoring and research findings to management agencies can broaden awareness of studied conditions and stimulate informed responses. Likewise, for scientists involved in monitoring, notification of proposed or known activities in monitored areas can support more complete investigations and interpretations of monitoring results. Additional research will be necessary to address new or long-term information needs. Management planning and actions will continue to evolve as progress occurs in recovering *A. wheeleri*.

9.1 Improve coordination of monitoring and research activities with management activities. This task will provide for prompt and thorough distribution of relevant monitoring and research findings to management agencies and other interested parties. It also will provide for scientists involved in monitoring and field research to be notified of inventoried activities and proposed developments. Appropriate access to information will be provided where full dissemination is not desirable.

9.2 Refine ability to correlate basin conditions and human activities with habitat conditions. Determining the relationships between various basin conditions and instream habitat conditions will enhance Ouachita rock pocketbook recovery. This task will clarify such relationships, by evaluating information from other tasks (e.g., as exchanged in Task 9.1) and conducting additional investigations, as needed.

9.3 Refine ability to identify and implement appropriate treatments and responses for identified threats/sources of degradation. Species recovery would benefit by ensuring that effective treatment measures are prescribed expeditiously to counteract unavoidable and accidental disturbances, and that capabilities exist for their implementation. This task will promote familiarity with effective treatments for a variety of likely environmental disturbances, and also will promote advance provision for treatment implementation.

9.4 Develop and implement an expanded habitat restoration-protection plan for all areas inhabited by the Ouachita rock pocketbook. Experience developing Task 1.25, information obtained from other tasks, and progress in habitat restoration will allow expansion of strategic planning to all areas of important habitat for *A. wheeleri*. Subtasks essentially similar to those performed for the Kiamichi River will be performed, including inventory of property ownerships and water rights, landowner notification, managed response to identified threats, protection of specific properties, and integration of initial protections into a systematic protection plan.

9.5 Develop enhanced notification and consultation procedures. FWS assistance in consultations can be facilitated by having accurate information on current and proposed activities provided as early as possible. Federal and state agencies having management responsibility within the range of the Ouachita rock pocketbook should keep the FWS informed of activities potentially affecting the species, from the time such activities are first given serious consideration. Based on agency contacts and other sources, the FWS should compile a list of ongoing, authorized, or proposed projects and activities. The FWS also should improve its capabilities to evaluate projects for potential threats to *A. wheeleri*, considering direct, indirect, and cumulative effects. Upon evaluation, the agencies involved should be informed of the nature and extent of potential threat to the Ouachita rock pocketbook posed by their projects or activities. Early efforts should be made to ensure that threats are avoided.

9.6 Develop strategy and capabilities for preservation of the Ouachita rock pocketbook against potentially drastic threats, such as future invasion of native habitats by the zebra mussel, *Dreissena polymorpha*. Since its introduction to the U.S. in 1986, the zebra mussel has spread up the Arkansas River system into Oklahoma, but has not yet invaded the Red River system where *A. wheeleri* occurs. Zebra mussels are prolific and tolerant to a variety of environmental conditions. They also attach themselves to a variety of underwater surfaces, including mussel shells. Where zebra mussels have become established, native mussels often decline dramatically. Zebra mussels may soon reach waters inhabited historically by the Ouachita rock pocketbook. If zebra mussels become established, *A. wheeleri* and other native mussels may be adversely impacted. Possible effects of the zebra mussel on the Ouachita rock pocketbook should be predicted, based on effects seen on other native species, and measures taken to counteract such effects. In addition to the threat of the zebra mussel, *A. wheeleri* remains vulnerable to other catastrophic threats, especially so long as only one healthy population exists. Although artificial propogation is not a primary recovery strategy, development of captive propagation facilities and techniques and

cryopreservation of reproductive products are contingency measures that should be taken in response to the possibility of a catastrophic event.

9.61 Develop necessary resources for captive propagation of the Ouachita rock pocketbook. Preceding tasks (e.g., 4-7) may develop procedures for propagation of *A. wheeleri* but in most cases will establish only small experimental populations. This task would develop the necessary facilities and culture techniques to maintain a captive, reproducing population. Such measures are necessary to provide animals for reintroduction in the event of disastrous losses or to supplement depleted populations.

9.62 Perform cryogenic preservation for the Ouachita rock pocketbook. Cryogenic preservation could maintain genetic material from all extant populations of the species. If a population were lost to a catastrophic event, cryogenic preservation could allow for eventual reestablishment using the genetic material preserved from that population.

9.7 Determine and provide continued protection and restoration needs for delisting of the Ouachita rock pocketbook. The tentative delisting criterion requires establishment and permanent protection of viable populations in four stream systems historically inhabited by *A. wheeleri*. Information does not exist indicating that the long-term survival of the Ouachita rock pocketbook could be ensured by restoration within a smaller area, or would require a greater area. The delisting criterion and the management actions needed to achieve recovery will evolve as additional information is obtained. If the species is to be removed from the Federal List of Endangered and Threatened Animals and Plants and the protection afforded by the Endangered Species Act, then alternative programs must be in place that ensure adequate protection of habitat and populations in perpetuity.

9.71 Establish and permanently protect viable populations in all four stream systems historically inhabited by the species, if those populations do not already exist. Ouachita rock pocketbooks should be relocated from suitable sources to other sites within its natural range, if necessary to meet the recovery objective. Transplants should continue until populations are found to be successfully reestablished. Measures must be put in place to provide permanent protection to reestablished populations and their habitat, and must be effective enough to restore the populations to viable levels.

9.72 Refine delisting criterion, and provide any corresponding measures needed to support delisting of the Ouachita rock pocketbook. Knowledge obtained from completion of the preceding tasks will allow an improved assessment of the species' status and natural characteristics, including population size and density, habitat suitability, life history aspects, and those factors that limit the species' distribution and abundance. From that knowledge, recovery criteria can be defined that more specifically and comprehensively reflect the species' needs and sensitivities. The

refined criteria will indicate any additional measures needed to achieve full recovery of *A. wheeleri.*

C. Recovery Actions Specifically Addressing Endangered Species Act Listing Factors

When the Ouachita rock pocketbook was listed as an endangered species under the Endangered Species Act of 1973 (Act), four of the five factors necessary to list a species under the Act threatened the species' continued survival. The Ouachita rock pocketbook recovery plan addresses these threats by recommending a variety of recovery actions that, if implemented, will lead to the species' reclassification and delisting (Table 3).

TABLE 3. RECOVERY ACTIONS AND RELATED LISTING FACTORS FOR *ARKANSIA WHEELERI*

Listing Factor	Specific Threat to Ouachita Rock Pocketbook	Related Recovery Actions[1]
(A) the present or threatened destruction, modification, or curtailment of its habitat or range;	impoundment, channelization, flow modification, water quality degradation, stream channel disturbance	1.1, 1.2, 1.21, 1.22, 1.23, 1.24, 1.25, 1.3, 1.31, 1.32, 2.1, 2.2, 2.3, 3.1, 3.2, 3.21, 3.22, 3.23, 3.3, 4.1, 5.1, 5.2, 5.3, 7.2, 9.2, 9.4.
(B) overutilization for commercial, recreational, scientific, or educational purposes;	commercial harvest, scientific and/or recreational harvest	*Other mechanisms address this factor, such as the designation by Texas Parks and Wildlife, Oklahoma Department of Wildlife Conservation, and Arkansas Game and Fish Commission of several rivers as mussel sanctuaries (see pgs. 30 and 31).*
(C) disease or predation;	---	*Not considered a significant threat.*
(D) the inadequacy of existing regulatory mechanisms;	inadequate habitat protection and/or protection of Ouachita rock pocketbook populations	1.2, 1.24, 3.23, 7.4, 9.7.
(E) other natural or manmade factors affecting its continued existence.	exotic species invasion (Asian clam, zebra mussel)	9.6.

[1]Recovery Actions are detailed in the previous section, Narrative Outline for Recovery Actions.

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